What is claimed is:

1. A method for producing a semiconductor device, including the steps of:

forming an interconnection groove for forming an interconnection in an insulation film formed on a substrate,

stacking a metal film on said insulation film so as to bury said interconnection groove,

forming a passivation film exhibiting a function of preventing the electrolytic reaction of the metal film at the surface of the metal film stacked on said insulation film,

selectively removing the passivation film on a projecting portion existing at the surface of said metal film generated by the burying of said interconnection groove in the passivation film formed on said metal film by mechanical polishing and thereby exposing the projecting portion of the related metal at the surface, and

removing the projecting portion of said exposed metal film by electrolytic polishing and flattening the unevenness of the surface of said metal film generated due to the burying of said interconnection groove.

2. A method for producing a semiconductor device as set forth in claim 1, further including a step of

removing excess metal film present on the insulation film from the metal film with the flattened surface by electrolytic composite polishing combining electrolytic polishing and mechanical polishing so as to form an interconnection.

3. A method for producing a semiconductor device as set forth in claim 2, wherein said electrolytic composite polishing combines electrolytic polishing and chemical mechanical polishing.

4. A method for producing a semiconductor device as set forth in claim 2, further including the steps of:

forming a barrier film comprised of a conductive material for preventing diffusion of said metal film to said insulation films so as to cover said insulation film and the inside of said groove after forming the interconnection groove and removing the excess metal film present on the insulation film by electrolytic composite polishing until the barrier film is exposed at its surface after a projecting portion of the exposed metal film is flattened, and

removing the excess barrier film present on the insulation film by electrolytic composite polishing until the insulation film is exposed at its surface.

5. A method for producing a semiconductor device as set forth in claim 4, further including the steps of:

interposing an electrolyte between the polishing surface of the polishing tool having conductivity and the passivation film and supplying a voltage between the metal film and barrier film and the polishing tool using the metal film and barrier film as an anode and the polishing tool as a cathode;

making the polishing tool move relative to the surface of the passivation film to selectively remove the passivation film formed on a projecting portion of the metal film; and

making the projecting portion of the metal film exposed from the selectively removed passivation film elute by the electrolytic action of the electrolyte.

6. A method for producing a semiconductor device as set forth in claim 5, further including the steps of:

bringing the electrode member supplied with voltage with the polishing tool into contact or proximity with said metal film and barrier film to pass a current to said metal film and barrier film, and

monitoring the current flowing to said polishing tool from said electrode member through said metal film and barrier film and managing the progress of polishing of said metal film and barrier film based on the magnitude of the value of said current.

7. A method for producing a semiconductor device

as set forth in claim 5, further including the steps of:

bringing the electrode member supplied with voltage with the polishing tool into contact or proximity with said metal film and barrier film to pass a current to said metal film and barrier film, and

monitoring the magnitude of the electrical resistance occurring between said electrode member and said polishing tool and managing the progress of polishing of said metal film and barrier film based on the value of the electrical resistance.

8. A method for producing a semiconductor device as set forth in claim 5, further including a step of interposing a chemical polishing agent including a polishing abrasive between the polishing surface of said polishing tool and said passivation film and selectively removing said passivation film.

9. A method for producing a semiconductor device as set forth in claim 5, further including a step of removing said excess metal film and barrier film by using different chemical polishing agents with high polishing rates with respect to the materials comprising the metal film and barrier film.

10. A method for producing a semiconductor device as set forth in claim 5, wherein the step of removing the excess barrier film includes a step of reducing the

voltage supplied between the barrier film and polishing tool from the voltage supplied between the metal film and polishing tool in the step of removing the excess metal film.

11. A method for producing a semiconductor device as set forth in claim 2, wherein:

the step of forming the interconnection groove includes the step of forming a contact hole for connecting an impurity diffusion layer or interconnection formed at a layer below the insulation film with an interconnection formed on said insulation film together with forming an interconnection use groove, and

in the step of burying the interconnection groove with metal, the contact hole is buried together with the interconnection groove with metal.

12. A method for producing a semiconductor device as set forth in claim 11, wherein

copper is used for the material forming the interconnection, and

the interconnection groove and contact hole are buried with copper using an electroplating process.

13. A method for producing a semiconductor device as set forth in claim 4, wherein any of Ta, Ti, TaN, and TiN is used for the material forming the barrier film.

14. A method for producing a semiconductor device

as set forth in claim 1, wherein the passivation film comprises an oxide film obtained by oxidizing the surface of the metal film.

15. A method for producing a semiconductor device as set forth in claim 14, wherein said oxide film is formed by supplying an oxidizing agent to the surface of said metal film.

16. A method for producing a semiconductor device as set forth in claim 1, wherein said passivation film forms on the surface of the metal film a film comprised of a material exhibiting an action of preventing an electrolytic reaction of a metal comprising the metal film.

17. A method for producing a semiconductor device as set forth in claim 16, wherein said passivation film forms on the surface of the metal film one of a water-repelling film, oil film, antioxidant film, a film comprised of a surfactant, a film comprised of a chelating agent, and a film comprised of a silane coupling agent.

18. A method for producing a semiconductor device as set forth in claim 1, wherein said passivation film has a higher electrical resistance and a lower mechanical strength than said metal film.

19. A polishing apparatus comprising:

a polishing tool having a polishing surface and having conductivity;

a polishing tool rotating and holding means for rotating said polishing tool about a predetermined axis of rotation and holding the same;

a rotating and holding means for holding a polishing object and rotating the same about a predetermined axis of rotation;

a movement and positioning means for moving and positioning said polishing tool to a target position in a direction facing said polishing object;

a relative moving means for making the polished surface of said polishing object and the polishing surface of said polishing tool relatively move along a predetermined plane;

an electrolyte feeding means for feeding an electrolyte onto the polished surface of said polishing object; and

an electrolytic current supplying means for supplying an electrolytic current flowing through said polishing tool through said electrolyte from said polished surface by using the polished surface of said polishing object as an anode and said polishing tool as a cathode.

20. A polishing apparatus as set forth in claim 19,

further comprising a polishing agent feeding means for feeding a chemical polishing agent including a polishing abrasive on to the polished surface of the polished object.

21. A polishing apparatus as set forth in claim 19, wherein said electrolytic current supplying means comprises:

a current supplying means arranged to be able to be brought into contact or proximity with the polished surface of said polished object and supply current to the polished surface using the polished surface of the polished object as an anode, and

a DC power supply supplying a predetermined DC power between said current supplying means and said polishing tool.

22. A polishing apparatus as set forth in claim 21, wherein said DC power supply outputs a pulse-like voltage of a predetermined period.

23. A polishing apparatus as set forth in claim 21, wherein

said polishing tool comprises a wheel-shaped conductive member and one annular end face of said member comprises a polishing surface, and

said current supplying means comprises a conductive electrode plate provided at the inside of the

polishing tool away from the polishing tool, held by said rotation and holding means, and rotated along with said polishing tool.

24. A polishing apparatus as set forth in claim 23, wherein said electrode plate comprises a scrub member having a surface for scrubbing the polished surface at the side facing the polished surface of the polished object.

25. A polishing apparatus as set forth in claim 24, wherein said scrub member is formed from a material which absorbs the electrolyte and the chemical polishing agent including the polishing abrasive and able to supply a current and supplies the electrolyte and/or chemical polishing agent supplied from said electrode plate side to the polished surface of said polished object.

26. A polishing apparatus as set forth in claim 21, wherein said polishing tool is held by a conductive member connected with said rotation and holding means and is supplied with current through a conductive brush contacting said rotating conductive member.

27. A polishing apparatus as set forth in claim 23, wherein said electrode plate comprises a metal more precious than the electrolyzed metal formed on the polished surface of the polished object.

28. A polishing apparatus as set forth in claim 19,

further comprising a current detecting means for detecting a value of an electrolytic current flowing from the polished surface of said polished object to said polishing tool.

29. A polishing apparatus as set forth in claim 23, further comprising a resistance value detecting means for detecting an electrical resistance between said electrode plate and said polishing tool through the polished surface of said polished object.

30. A polishing apparatus as set forth in claim 29, further comprising a control means for controlling a position of a facing direction of said polishing tool and said polished object so that the value of the electrolytic current becomes constant based on a detection signal of said current detecting means.

31. A polishing apparatus which comprises a polishing tool having a polishing surface which contacts the entire surface of the polished surface of the polishing object while rotating and which brings said polishing object into contact with said polished surface while rotating it so as to flatten and polish the same, said polishing apparatus comprising:

an electrolyte feeding means for feeding an electrolyte onto said polishing surface, and

an anode electrode and a cathode electrode

capable of supplying electric power to the polished surface of said polishing object in said polishing surface,

said polishing apparatus flattening and polishing flattens and polishes the polished surface of said polishing object by electrolytic composite polishing which combines electrolytic polishing by said electrolyte and mechanical polishing by said polishing surface.

32. A polishing apparatus as set forth in claim 31, further comprising a polishing agent feeding means for feeding a chemical polishing agent including a polishing abrasive to the polishing surface, and

said polishing apparatus flattening and polishing the polished surface of the polished object by electrolytic composite polishing combining electrolytic polishing by said electrolyte and chemical mechanical polishing by said polishing surface and said polishing agent.

33. A polishing method including the steps of:

pushing the polishing surface of a conductive polishing tool and the surface of the polishing object with a metal film formed on at least the surface or an inner layer against each other while interposing the electrolyte therebetween;

supplying the electrolytic current flowing from

the surface of said polishing object to said polishing tool through said electrolyte by using said polishing tool as a cathode and the surface of said polishing object as an anode,

making said polishing tool and said polishing object move relatively along a predetermined plane while rotating the two; and

flattening the metal film formed on said polishing object by electrolytic composite polishing combining electrolytic polishing by the electrolyte and mechanical polishing by the polishing surface.

34. A polishing method as set forth in claim 33, further including the step of interposing a chemical polishing agent containing a polishing abrasive together with said electrolyte between the polishing surface and the surface of the polished object and flattening the metal film formed on the polished object by electrolytic composite polishing combining electrolytic polishing by said electrolyte and chemical mechanical polishing by said polishing surface and said polishing agent.

35. A polishing method as set forth in claim 33, wherein

said polished object comprises a stack of a plurality of films comprised of different materials, and

the current flowing from the surface of the

polished object to the polishing tool through the electrolyte, changing in response to differences in the electrical characteristics of the materials of the films, is monitored and the progress in the polishing is managed based on the magnitude of the electrolytic current.

36. A polishing method as set forth in claim 33, further including the step of supplying a pulse-like voltage of a predetermined period between the polishing tool and the surface of the polished object to supply said electrolytic current.

37. A polishing method as set forth in claim 33, further including the step of bringing an electrode member into proximity or contact with the surface of the polished object supplied with the electrolyte to supply current to the surface of the polished object.

38. A polishing method as set forth in claim 37, further including the step of supplying current to the metal film formed on said polished object while making said electrode member rotate along with said polishing tool and making it move relatively with respect to the polished object.

39. A polishing method as set forth in claim 37, further including the step of managing the progress of the polishing of the polished object based on the magnitude of the electrical resistance between said

electrode member and said polishing tool through the surface of the polished object.

40. A polishing method as set forth in claim 34, further including the step of positively charging the polishing abrasive contained in the polishing agent.

41. A polishing method including the steps of:

forming a passivation film exhibiting a function of preventing an electrolytic reaction of the metal film at the surface of the metal film formed on the polishing object;

pushing the polishing surface of a conductive polishing tool and a metal film against each together while interposing an electrolyte between the polishing surface and the metal film, and then applying a predetermined voltage between said polishing tool and said metal film;

making the polishing surface of said polishing tool and the metal film of said polishing object move relatively along a predetermined plane and selectively removing a passivation film on a projecting portion projected from the polishing surface of said polishing tool in said metal film by mechanical polishing by said polishing tool; and

removing a projecting portion of the metal film exposed at the surface due to the removal of said

passivation film by the electrolytic polishing function by said electrolyte and flattening said metal film.

42. A polishing method as set forth in claim 41, further including the step of interposing a chemical polishing agent containing a polishing abrasive together with said electrolyte between the polishing surface and the metal film and selectively removing the passivation film by chemical mechanical polishing by said polishing surface and said polishing agent.

43. A polishing method as set forth in claim 41, wherein said passivation film comprises of an oxide film formed by oxidizing the surface of said metal film.

44. A polishing method as set forth in claim 41, wherein said passivation film forms a film comprised of a material exhibiting an action of inhibiting an electrolytic reaction of the metal comprising said metal film on the surface of said metal film.

45. A polishing method as set forth in claim 41, wherein said passivation film is higher in electrical resistance and lower in mechanical strength compared with the metal film.

46. A polishing method as set forth in claim 41, further including the step of bringing an electrode member into proximity or contact with the surface of the metal film to supply current to the surface of the metal

film.

47. A polishing method as set forth in claim 46, further including the step of managing the progress of the polishing based on the magnitude of the electrical resistance between said electrode member and said polishing tool.

48. A polishing method as set forth in claim 42, further including the step of positively charging the polishing abrasive contained in the polishing agent.